



UNIVERSITI PUTRA MALAYSIA

**EFFECTS OF PROBLEM BASED LEARNING ON MATHEMATICS PERFORMANCE,
INSTRUCTIONAL EFFICIENCY AND AFFECTIVE ATTRIBUTES IN SECONDARY
SCHOOLS, PORT DICKSON, MALAYSIA**

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By

NUR IZZATI LOJININ BT ABDULLAH

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AUGUST 2008

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Faculty: Institute for Mathematical Research

Problem Based Learning (PBL) is an engaging instructional strategy in which students are given 'triggers' or realistic, simulated problems that are puzzling, vague or ambiguous before they experience any instruction in a specific content area. Previous research had discovered that students are trained to develop critical thinking, are adaptable to change, able to work independently, demonstrate effective communication skills and become continual learners through PBL.

A quasi experimental study with non-equivalent control group posttest only design was conducted to investigate the effects of PBL on Form Four Malaysian students' mathematics performance and instructional

efficiency. The experiment was carried out for six weeks involving 53 Form Four students randomly selected from the district of Port Dickson. The experimental group (n=29) were exposed to the PBL instruction whereas the control group (n=24) were taught conventionally.

There were five instruments used in this study namely, a posttest, Paas Mental Effort Rating Scale, learning assessments during the acquisition phase, a questionnaire on perception towards group work, interest in mathematics and perception towards mathematics learning experience and a rubric evaluating students' effective use of Polya's problem solving procedures, mathematical communication and teamwork.

The results indicated that there was no significance difference in the mean scores of the overall mathematics performance ($F = 1.46$, $p > .05$) between the PBL group ($M=67.38$, $SD=19.75$) and the CT group ($M=60.58$, $SD=17.90$). On the other hand, there was a significance difference in mean mental effort per test problem for the PBL group ($M=5.02$, $SD=1.60$), and the CT group ($M=3.90$, $SD=1.38$; $t(51) = 2.70$, $p < .05$). An independent sample t-test conducted on the mean relative condition efficiency index showed that there was no significant difference ($t(51) = -1.70$, $p < .05$) between the PBL group ($M = -0.26$, $SD=1.26$) and the CT group ($M = 0.32$, $SD=1.22$).

The findings of the study showed that the PBL group used the Polya's problem solving procedures more effectively, displayed better mathematical communication skills and showed stronger teamwork compared to the CT group. However, minimal differential effect on mathematics performance and instructional efficiency was obtained between the PBL and CT group. Hence, this indicated that the efficacy of PBL has yet to be explored in enhancing mathematical performance and to develop problem solving skills, critical thinking and communication skills among learners.

Overall, the PBL instructional strategy has promising implications in teaching and learning of Form Four mathematics specifically in enhancing thinking and communication skills among learners in order to develop critical, creative and competent human capital with first-class mentality who are able to face and overcome the challenges of globalisation in Malaysia.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

**KESAN STRATEGI PENGAJARAN PROBLEM BASED LEARNING
TERHADAP PENCAPAIAN MATEMATIK, KEBERKESANAN
PENGAJARAN DAN ATRIBUT AFEKTIF DI SEKOLAH MENENGAH,
PORT DICKSON, MALAYSIA**

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Pembelajaran Berasaskan Masalah (PBM) atau *Problem Based Learning* (PBL) adalah satu strategi pengajaran menarik di mana pelajar diberikan 'pencetus' atau simulasi masalah yang kurang jelas dan kabur sebelum mempelajari isi kandungan sesuatu pelajaran. Kajian terdahulu mendapati bahawa melalui pembelajaran secara PBL pelajar dilatih untuk berfikir secara kritis, mudah menyerap perubahan, berdikari, menunjukkan kemahiran berkomunikasi serta mengamalkan pembelajaran berterusan.

Satu kajian kuasi-eksperimen dengan reka bentuk ujian pos sahaja bagi kumpulan kawalan tidak serupa dikendalikan untuk mengkaji kesan PBL ke atas prestasi dan keberkesanan strategi pengajaran PBL (*instructional*

efficiency) pelajar Tingkatan Empat di Malaysia. Eksperimen yang dikendalikan selama enam minggu ini melibatkan 53 pelajar Tingkatan Empat yang dipilih secara rawak dari sebuah sekolah di daerah Port Dickson. Kumpulan eksperimen ($n=29$) telah didedahkan dengan pengajaran secara PBL manakala kumpulan kawalan ($n=24$) menjalani pembelajaran menggunakan strategi pengajaran konvensional.

Terdapat lima instrumen yang digunakan dalam kajian ini iaitu lembaran kerja matematik, ujian pos, *Paas Mental Effort Rating Scale*, soal selidik persepsi tentang bekerja dalam kumpulan, minat terhadap matematik dan persepsi terhadap pengalaman pembelajaran yang dilalui dan rubrik yang mengukur penggunaan kaedah penyelesaian masalah Polya, komunikasi matematik dan kerjasama berkumpulan.

Dapatan kajian menunjukkan bahawa tiada perbezaan yang signifikan dalam skor min ujian pencapaian matematik ($F = 1.46$, $p > .05$) antara kumpulan PBL ($M=67.38$, $SD=19.75$) dan kumpulan konvensional ($M=60.58$, $SD=17.90$). Sebaliknya, terdapat perbezaan signifikan dalam min *mental effort per test problem* antara kumpulan PBL ($M=5.02$, $SD=1.60$) dan kumpulan konvensional ($M=3.90$, $SD=1.38$; $t(51) = 2.70$, $p < .05$). Analisis t-test tidak bersandar yang dijalankan terhadap min *relative condition efficiency index* menunjukkan tiada perbezaan signifikan

($t(51) = -1.70, p < .05$) antara kumpulan PBL ($M = -0.26, SD = 1.26$) dan kumpulan konvensional ($M = 0.32, SD = 1.22$).

Dapatan kajian juga menunjukkan bahawa kumpulan PBL didapati menggunakan kaedah penyelesaian masalah Polya dengan lebih berkesan, menunjukkan kemahiran komunikasi matematik yang lebih baik dan kerjasama berkumpulan yang lebih kukuh berbanding kumpulan CT. Walaubagaimanapun, tiada perbezaan ketara dari segi pencapaian matematik dan keberkesanan strategi pengajaran (*instructional efficiency*) antara kumpulan PBL dan kumpulan konvensional. Ini menunjukkan bahawa keberkesanan strategi pengajaran PBL perlu diterokai lagi dalam meningkatkan pencapaian matematik dan juga mengembangkan kemahiran menyelesaikan masalah, pemikiran kritis dan kemahiran berkomunikasi di kalangan pelajar.

Secara keseluruhan strategi pengajaran secara PBL menunjukkan implikasi yang memberangsangkan dalam pengajaran dan pembelajaran matematik Tingkatan Empat terutama sekali dalam membentuk kemahiran berfikir dan berkomunikasi di kalangan pelajar. Ini adalah penting untuk membangunkan modal insan yang kreatif dan berkebolehan serta mempunyai mentaliti kelas pertama dalam menghadapi dan menangani cabaran globalisasi di Malaysia.

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I certify that an Examination Committee has met on **25 August 2008** to conduct the final examination of Nur Izzati Lojinin bt. Abdullah on her Master of Science thesis entitled “**EFFECTS OF PROBLEM BASED LEARNING ON MATHEMATICS PERFORMANCE AND AFFECTIVE ATTRIBUTES IN LEARNING STATISTICS AT FORM FOUR SECONDARY LEVEL**” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not currently, submitted for any other degree at Universiti Putra Malaysia or any other institution.

Nur Izzati Lojinin Bt Abdullah

Date: 24 November 2008

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ABBREVIATIONS

ANCOVA	Analysis of Covariance
CDC	Curriculum Development Centre
CLT	Cognitive Load Theory
CT	Conventional Teaching
EDA	Exploratory Data Analysis
EPRD	Educational Planning and Research Division
ICT	Information and Communications Technology
JPNS	Education Department of Negeri Sembilan
KBSM	New Curriculum for Secondary School
KBSR	New Curriculum for Primary School
MOE	Ministry of Education
NCTM	National Council for Teachers of Mathematics
PBL	Problem Based Learning
PMR	Lower Certificate Examination

SDT	Social Development Theory
SPM	Malaysian Certificate of Education
SPSS	Statistical Package for the Social Science
STPM	Higher Certificate of Education
TIMSS	Trends in International Mathematics and Science
UPSR	Primary School Evaluation Examination
WM	Working Memory
ZPD	Zone of Proximal Development

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Science and Technology is instrumental in achieving Malaysia's aspirations as stated in Vision 2020. The vision was proposed by the country's fourth Prime Minister, Tun Dr Mahathir Mohamad. In his presentation to the Malaysian Business Council in 1992, nine challenges were posed in order to achieve a developed nation status. The sixth challenge of the vision was "establishing a scientific and progressive society, a society that is innovative and forward-looking, one that is not only a consumer of technology but also a contributor to the scientific and technological civilisation of the future." (Vision 2020, 1997). Concurrently, Malaysia has charted a chronological order of the nation's development policies and plans that has been and is in the process of being implemented in order to achieve a knowledge-based economy (k-economy) that will advance the country's economic growth and competitiveness (refer to Table 1.1).

These plans were initiated in order to build up more knowledgeable workers who not only are able to utilise technology but are also productive in contributing to the development of a scientific, technological, progressive, ethical, moral and caring society (Nik Azis, 2005).